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# APPENDIX A

MANUAL FOR NONCOMMISSIONED OFFICERS AND PRIVATES OF INFANTRY OF THE ORGANIZED MILITIA AND VOLUNTEERS OF THE UNITED STATES, 1914.

# Military Map Reading

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GOVERNMENT PRINTING OFFICE
1915

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OFFICE OF THE CHIEF OF STAFF.

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WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
*Washington, January 8, 1915.*

The following appendix to the Manual for Noncommissioned Officers and Privates of Infantry of the Organized Militia and Volunteers of the United States, 1914, on the subject of military map reading, prepared at the request of the Division of Militia Affairs, War Department, by Capt. Charles D. Herron, Tenth Infantry, is approved and herewith published for the information and government of all concerned.

By order of the Secretary of War:

A. L. MILLS,
*Brigadier General, Acting Chief of Staff.*



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## MILITARY MAP READING.

When you pick up a map, the first question is, Where is the north? This can usually be told by an arrow (see fig. 1, p. 6) which will be found in one of the corners of the map, and which points to the true north—the north of the north star.

On some maps no arrow is to be found. The chances are a hundred to one that the north is at the top of the map, as it is on almost all printed maps. But you can only assure yourself of that fact by checking the map with the ground it represents. For instance, if you ascertain that the city of Philadelphia is due east of the city of Columbus, then the Philadelphia-Columbus line on the map is a due east-and-west line, and establishes at once all the other map directions.

Now, the map represents the ground as nearly as it can be represented on a flat piece of paper. If you are standing up facing the north, your right hand will be in the east, your left in the west, and your back to the south. It is the same with a map; if you look across it in the direction of the arrow—that is, toward its north—your right hand will be toward what is east on the map; your left hand to the west; the south will be at the bottom of the map.

There is another kind of an arrow that sometimes appears on a map. It is like the one in figure 2, page 6, and points not to the true north, but to the magnetic north, which is the north of the compass. Though the compass needle, and therefore the arrow that represents it on the map, does not point exactly north, the deviation is, from a military point of view, slight, and appreciable error will rarely result through the use of the magnetic instead of the true north in the solution of any military problems.

Should you be curious to know the exact deviation, consult your local surveyor or any civil engineer.

Both arrows may appear on your map. In that case disregard the magnetic arrow unless you are using the map in connection with a compass.



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Fig. 1.

Fig. 2.

Fig. 5.

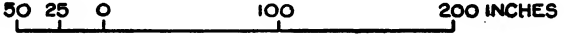


Fig. 3.

Fig. 4.

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If a map is being used on the ground, the first thing to be done is to put the lines of the map parallel to the real outlines of the ground forms, and roads, fences, railroads, etc., that the map shows; for the making of a map is no more than the drawing on paper of lines parallel to and proportional in length to real directions and distances on the ground.

For instance, the road between two places runs due north and south. Then on the map a line representing the road will be parallel to the arrow showing the north and will be proportional in length to the real road. In this way a map is a picture, or, better, a bare outline sketch; and, as we can make out a picture, though it be upside down, or crooked on the wall, so we can use a map that is upside down or not parallel to the real ground forms. But it is easier to make out both the picture and the map if their lines are parallel to what they represent. So in using a map on the ground we always put the lines parallel to the actual features they show. This is easy if the map has an arrow.

If the map has no arrow, you must locate some objects or features on the ground, and on the map, theis representations. Draw on the map a line connecting any two of the features; place this line parallel to an imaginary line through the two actual features located, and your map will be correctly placed. Look to it that you do not reverse on the map the positions of the two objects or features, or your map will be exactly upside down.

When the map has been turned into the proper position—that is to say, "oriented"—the next thing is to locate on the map your position. If you are in the village of Easton and there is a place on the map labeled Easton, the answer is apparent. But if you are out in the country, at an unlabeled point that looks like any one of a dozen other similar points, the task is more complicated. In this latter case you must locate and identify, both on the map and on the ground, other points—hills, villages, peculiar bends in rivers, forests—any ground features that have some easily recognizable peculiarity and that you can see from your position.

Suppose, for instance, you were near Leavenworth and wanted to locate your exact position, of which you are uncertain. You have the map shown in this pamphlet, and, looking about, you see southwest from where you stand the United States Penitentiary; also, halfway between the south and the southeast—south-southeast a

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sailor would say—the reservoir (rectangle west of "O" in "Missouri"). Having oriented your map, draw on it a line from the map position of the reservoir toward its actual position on the ground. Similarly draw a line from the map position of penitentiary toward its actual position. Prolong the two lines until they intersect; the intersection of the lines will mark the place where you stand—south Merritt Hill.

This method consists merely in drawing on the map lines that represent the lines of sight to known and visible places. The lines pass through the map position of the places you see and are parallel to the actual lines of sight; therefore they are the map representations of the lines of sight, and their intersection is the map position of the eye of the observer.

After this orientation and location of position, one can deduce from the map everything there is to know in regard to directions. In this respect, study of the ground itself will show no more than will study of the map.

After "What direction?" comes "How far?" To answer this, one must understand that the map distance between any two points shown bears a fixed and definite relation or proportion to the real distance between the two points.

For instance: We measure on a map and find the distance between two points to be 1 inch. Then we measure the real distance on the ground and find it to be 10,000 inches; hence the relation between the map distance and the real distance is 1 to 10,000, or $\frac{1}{10000}$. Now, if the map is properly drawn the same relation will hold good for all distances, and we can obtain any ground distance by multiplying by 10,000 the corresponding map distance.

This relation need not be $\frac{1}{10000}$, but may be anything from $\frac{1}{100}$ that an architect might use in making a map or plan of a house up to one over a billion and a half, which is about the proportion between map and real distances in a pocket-atlas representation of the whole world on a 6-inch page. Map makers call this relation the "scale" of the map and put it down in a corner in one of three ways.

For the sake of an illustration, say the relation between map and ground distances is 1 to 100; that is, 1 inch on the map is equal to 100 on the ground. The scale may be written:

First. 1 inch equals 100.

Second. $\frac{1}{100}$.

Third. As shown by figure 3 (p. 6).

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These expressions mean one and the same thing. A variation of the first method on a map of different scale might be: 1 inch equals 1 mile. Since a mile contains 63,360 inches, then the real distance between any two points shown on the map is 63,360 times the map distance.

To find the ground distance by the third kind of scale, copy it on the edge of a slip of paper, apply the slip directly to the map, and read off the distance; and so we answer the question, "How far?"

After direction and distance comes the interpretation of the signs, symbols, and abbreviations on the map. Those authorized are given, at the conclusion of the text, in a reprint of appendix 4, Field Service Regulations 1914; but there are a good many other conventional signs in common use. A key to them is published by the War Department and is called "Conventional Signs, United States Army." From these you read at once the natural and artificial features of the country shown on your map. It should be borne in mind that these conventional signs are not necessarily drawn to scale, as are the distances. They show the position and outline of the features, rather than the size. This, for the reason that many of the features shown, if drawn to scale, would be so small that one could not make them out except with a magnifying glass. If the exact dimensions are of any importance they will be written in figures on the map. For instance, bridges.

In addition to the above conventional signs, we have CONTOURS to show the elevations, depressions, slope, and shape of the ground. Abroad, HACHURES are much used, but they serve only to indicate elevation, and as compared to contours are of little value. Contours resemble the lines shown in figure 4 (p. 6).

Hachures are shown in figure 5 (p. 6) and may be found on any European map. They simply show slopes and, when carefully drawn, show steeper slopes by heavier shading and gentler slopes by the fainter hachures. The crest of the mountain is within the hachures. (See fig. 5, p. 6.)

*Contours.*—A certain student when asked by his instructor to define "space" said: "I have it, sir, in my head, but can not put it into words." The instructor replied: "I suppose that under those circumstances, Mr. ———, the definition really would not help much." And so it is with contours; the definition does not help much if you



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know a contour when you meet it on a map. For examples of contours turn to the map in the back of the pamphlet and, starting at the United States Penitentiary, note the smooth, flowing, irregular curved lines marked 880, 860, 840, 840, 860, etc.

The only other lines on the map that at all resemble contours are stream lines, like "Corral Creek," but the stream lines are readily distinguished from contours by the fact that they cross the contours squarely, while the contours run approximately parallel to each other. Note the stream line just to the west of South Merritt Hill.

The contours represent lines on the ground that are horizontal and whose meanderings follow the surface, just as the edge of a flood would follow the irregularities of the hills about it. Those lines that contours stand for are just as level as the water's edge of a lake, but horizontally they wander back and forth to just as great a degree.

The line marked 880 at the penitentiary passes through, on that particular piece of ground, every point that is 880 feet above sea level. Should the Missouri River rise in flood to 880 feet, the penitentiary would be on an island, the edge of which is marked by the 880 contour.

Contours show several things; among them the height of the ground they cross. Usually the contour has labeled on it in figures the height above some starting point, called the DATUM PLANE—generally sea level. If, with a surveying instrument, you put in on a piece of ground a lot of stakes, each one of which is exactly the same height above sea level—that is, run a line of levels—then make a map showing the location of the stakes, a line drawn on the map through all the stake positions is a contour and shows the position of all points of that particular height.

On any given map all contours are equally spaced in a vertical direction, and the map shows the location of a great number of points at certain fixed levels. If you know the vertical interval between any two adjacent contours, you know the vertical interval for all the contours on that map, for these intervals on a given map are all the same.

With reference to a point through which no contour passes, we can only say that the point in question is not higher than the next contour up the hill, nor lower than the next one down the hill. For the purposes of any problem, it is usual to assume that the ground

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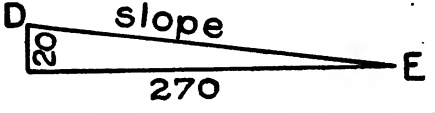
slopes evenly between the two adjacent contours, and that the vertical height of the point above the lower contour is proportional to its horizontal distance from the contour, as compared to the whole distance between the two contours. For instance, on the map, find the height of point A. The horizontal measurements are as shown on the map. The vertical distance between the contours is 20 feet. A is about one-quarter of the distance between the 800 and the 820 contours, and we assume its height to be one-quarter of 20 feet (5 feet) higher than 800 feet. So the height of A is 805 feet.

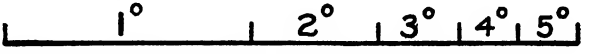
The vertical interval is usually indicated in the corner of the map by the letters "V. I." For instance: V. I=20 feet.

On maps of very small pieces of ground, the V. I. is usually small—perhaps as small as 1 foot; on maps of large areas on a small scale it may be very great—even 1,000 feet.

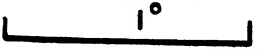
Contours also show SLOPES. It has already been explained that from any contour to the next one above it the ground rises a fixed number of feet, according to the vertical interval of that map. From the scale of distances on the map the horizontal distance between any two contours can be found. For example: On the map, the horizontal distance between D and E is 90 yards, or 270 feet. The vertical distance is 20 feet the V. I. of the map. The slope then is $\frac{20}{270}=\frac{1}{13.5}=7\frac{1}{2}\%=4\frac{1}{2}°$, in all of which different ways the slope can be expressed.




On a good many contoured maps a figure like this will be found in one of the corners:




On that particular map contours separated by the distance

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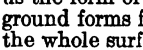
on the vertical scale show a slope of 1°; if separated by the distance




they show a 2° slope, etc. A slope of 1° is a rise of 1 foot in 57. To use this scale of slopes copy it on the edge of a piece of paper just as you did the scale of distances and apply it directly to the map.

You will notice that where the contours lie closest the slope is steepest; where they are farthest apart the ground is most nearly flat.

It has already been set forth how contours show height and slope; in addition to this they show the shape of the ground, or GROUND FORMS. Each single contour shows the shape at its particular level of the hill or valley it outlines; for instance, the 880 contour about the penitentiary shows that the hill at that level has a shape somewhat like a horse's head. Similarly, every contour on the map gives us the form of the ground at its particular level, and knowing these ground forms for many levels we can form a fair conception of what the whole surface is like.

A round contour like the letter O outlines a round ground feature; a long narrow one indicates a long narrow ground feature.

Different hills and depressions have different shapes. A good many of them have one shape at one level and another shape at another level, all of which information will be given you by the contours on the map.

One of the ways to see how contours show the shape of the ground is to pour half a bucket of water into a small depression in the ground. The water's edge will be exactly level, and if the depression is approximately round, the water's edge will also be approximately round. The outline will look something like figure 6.

Draw roughly on a piece of paper a figure of the same shape and you will have a contour showing the shape of the bit of ground where you poured your water.

Next, with your heel gouge out on one edge of your little pond a small round bay. The water will rush in and the watermark on the soil will now be shaped something like figure 7.

Alter your drawing accordingly, and the new contour will show the new ground shape.

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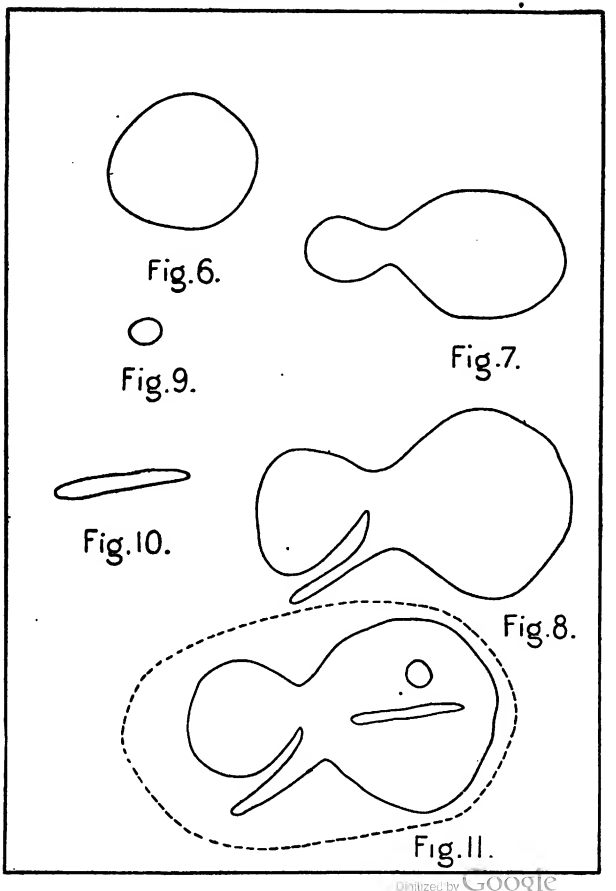


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Again do violence to the face of nature by digging with a stick a narrow inlet opening out of your miniature ocean, and the watermark will now look something like figure 8.

Alter your drawing once more and your contour shows again the new ground form. Drop into your main pond a round clod and you will have a new watermark, like figure 9, to add to your drawing. This new contour, of the same level with the one showing the limit of the depression, shows on the drawing the round island.

Drop in a second clod, this time long and narrow; the watermark will be like figure 10, and the drawing of it, properly placed, will show another island of another shape. Your drawing now will look like figure 11.

It shows a depression approximately round, off which open a round bay and a long narrow bay. There is also a round elevation and a long narrow one; a long, narrow ridge, jutting out between the two bays, and a short, broad one across the neck of the round bay.

Now flood your lake deeply enough to cover up the features you have introduced. The new water line, about as shown by the dotted line in figure 11, shows the oblong shape of the depression at a higher level; the solid lines show the shape farther down; the horizontal distance between the two contours at different points shows where the bank is steep and where the slope is gentler.

Put together the information that each of these contours gives you, and you will see how contours show the shape of the ground. On the little map you have drawn you have introduced all the varieties of ground forms there are; therefore all the contour forms.

The contours on an ordinary map seem much more complicated, but this is due only to the number of them, their length, and many turns before they finally close on themselves. Or they may close off the paper. But trace each one out, and it will resolve itself into one of the forms shown in figure 11.

Just as the high-tide line round the continents of North and South America runs a long and tortuous course, but finally closes back on itself, so will every contour do likewise. And just as truly as every bend in that high-tide mark turns out around a promontory, or in around a bay, so will every bend in a contour stand for a hill or a valley, pointing to the lowlands if it be a hill, and to the height if it mark a valley.

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If the map embrace a whole continent or an island, all the contours will be of closed form, as in figure 11, but if it embrace only a part of the continent or island, some of the contours will be chopped off at the edge of the map, and we have the open form of contours, as we would have if figure 11 were cut into two parts.

The closed form may indicate a hill or a basin; the open form, a ridge or a valley; sometimes a casual glance does not indicate which.

Take up, first, the contour of the open type. If the map shows a stream running down the inside of the contour, there is no difficulty in saying at once that the ground feature is a valley; for instance, V, V, V, and the valley of Corral Creek on the map. But if there is no stream line, does the contour bend show a valley or a ridge?

First of all, there is a radical difference between the bend of a contour round the head of a valley and its bend round the nose of a ridge.

Compare on the map the valleys V and the ridges R. The bend of the contour round the head of the valley is much sharper than the bend of the contour round the nose of the ridge. This is a general truth, not only in regard to maps, but also in regard to ground forms. Study any piece of open ground and note how much wider are the ridges than the valleys. Where you find a "hog back" or "devil's backbone," you have an exception to the rule, but the exceptions are not frequent enough to worry over.

To tell whether a given point is on a ridge or in a valley, start from the nearest stream shown on the map and work across the map to the undetermined point, keeping in mind that in a real trip across the country you start from the stream, go up the hill to the top of a ridge, down the other side of the hill to a watercourse, then up a hill to the top of a ridge, down again, up again, etc. That is all traveling is—valley, hill, valley, hill, valley, etc., though you wander till the crack o' doom. And so your map travels must go—valley, hill, valley, hill—till you run off the map or come back to the starting point.

On the map, follow the R–V line, V indicating valley and R ridge or hill. Note first the difference in sharpness in the contour bends; also how the valley contours point to the highland and the ridge contours to the lowland.

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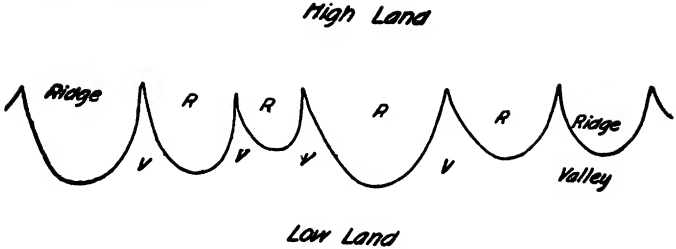
The contours go thus:




The streams flow down the valleys, and the sharp angle of the contour points always *up* stream. Note also how the junction of a stream and its tributary usually makes an angle that points *down* stream.

"Which way does this stream run?"

Water flows down hill. If you are in the bed of a stream, contours representing higher ground must be to your right and to your left. Get the elevations of these contours. Generally the nearest contour to the bank of the stream will cross the stream and there will be an angle or sharp turn in the contour at this crossing. If the point of the angle or sharp turn is toward you, you are going downstream; if away from you, you are going upstream.

If the contours are numbered, you have only to look at the numbers to say where the low and where the high places are; but to read a map with any speed one must be quite independent of these numbers. In ordinary map reading look, first of all, for the stream lines. The streams are the skeleton upon which the whole map is hung. Then pick out the hilltops and ridges and you have a body to clothe with all the details that will be revealed by a close and careful study of what the map maker has recorded.

As to closed contours, they may outline a depression or a hill. On the map, "881" or "885" might be hills or ponds, as far as their shape is concerned. But, clearly, they are hills, for on either side are small streams running *away* from them. If they were ponds the

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stream lines would run *toward* the closed contours. The test of "hill, valley, hill," will always solve the problem when there are not enough stream lines shown to make evident at once whether a closed contour marks a pond or a hill. Look in the beginning for the stream lines and valleys, and, by contrast, if for no other reason, the hills and ridges at once loom up.

To illustrate in armories the subject of contours to aid those who have difficulty in reading contoured maps the following is suggested:

1. Secure modeling clay and build a mound.

2. Use wire and slice this mound horizontally at equal vertical intervals into zones; then insert vertical dowels through the mound of clay.

3. Remove the top zone, place on paper, and draw outline of the bottom edge. Trim your paper roughly to the outline drawn. Indicate where the holes made by the dowels pierce the paper.

4. Do the above with each zone of your mound.

5. Place these papers in proper order on dowels similarly placed to ones in original mound at, say, 1 inch vertical interval apart. A skeleton mound results.

6. Replace the zones of the clay mound and form the original clay mound along the side of skeleton mound.

7. Now force all the paper sheets down the dowels onto the bottom sheet, and we have a map of clay mound with contours.

NOTE.—One-inch or 2-inch planks can be made into any desired form by the use of dowels and similar procedure followed.

People frequently ask, "What should I see when I read a map"? and the answer is given, "The ground as it is." This is not true any more than it is true that the words, "The valley of the Meuse," bring to your mind vine-clad hills, a noble river, and green fields where cattle graze. Nor can any picture ever put into your thought what the Grand Canyon really is. What printed word or painted picture can not do, a map will not. A map says to you, "Here stands a hill," "Here is a valley," "This stream runs so," and gives you a good many facts in regard to them. But you do not have to "see" anything, any more than you have to visualize Liege in order to learn the facts of its geography. A map sets forth cold facts in an alphabet all its own, but an easy alphabet, and one that tells with a few curving lines more than many thousand words could tell.

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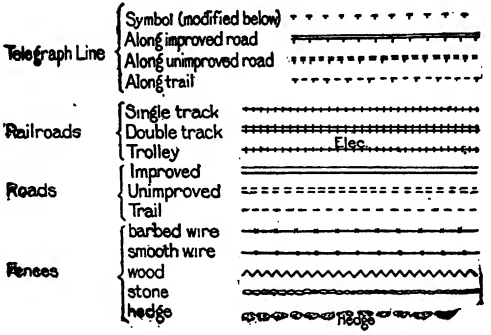
## Field Maps and Sketches.

The following abbreviations and signs are authorized for use on field maps and sketches. For more elaborate map work the authorized conventional signs as given in the manual of "Conventional Signs, United States Army Maps," are used. Abbreviations other than those given should not be used.

ABBREVIATIONS.

| | | | | | |
|---|---|---|---|---|---|
| A. | Arroyo. | G. S. | General Store. | Pt. | Point. |
| abut. | Abutment. | gir. | Girder. | q.p. | Queen-post |
| Ar. | Arch. | G. M. | Gristmill. | R. | River. |
| b. | Brick. | I. | Iron. | R. H. | Roundhouse. |
| B. S. | Blacksmith Shop. | I. | Island. | R. R. | Railroad. |
| bot. | Bottom. | Jc. | Junction. | S. | South. |
| Br. | Branch. | k.p. | King-post. | s. | Steel. |
| br. | Bridge. | L. | Lake. | S. H. | Schoolhouse. |
| C. | Cape. | Lat. | Latitude. | S. M. | Sawmill. |
| cem. | Cemetery. | Ldg. | Landing. | Sta. | Station. |
| con. | Concrete. | L. S. S. | Life-Saving Station. | st. | Stone. |
| cov. | Covered. | L. H. | Lighthouse | str. | Stream. |
| Cr. | Creek. | Long. | Longitude. | T. G. | Tollgate. |
| d. | Deep. | Mt. | Mountain. | Tres. | Trestle. |
| cul. | Culvert. | Mts. | Mountains. | tr. | Truss. |
| D. S. | Drug Store. | N. | North. | W. T. | Water Tank. |
| E. | East. | n. f. | Not fordable. | W. W. | Water Works. |
| Est. | Estuary. | P. | Pier. | W. | West. |
| f. | Fordable. | pk. | Plank. | w. | Wood. |
| Ft. | Fort. | P. O. | Post Office. | wd. | Wide. |

SIGNS—FIELD MAPS AND SKETCHES.

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Bridge

Indicate character and span by abbreviations.

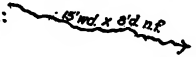
Example:


$\frac{40 \times 20}{10}$

Meaning wooden king post bridge, 40 feet long, 20 feet wide, and 10 feet above the water.

Streams

Indicate character by abbreviations.

Example: 


Meaning a stream 15 feet wide, 8 feet deep, and not fordable.

House - Church ♁ School house ⁎S.H.

Woods


Orchards

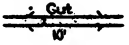
Cultivated Land


If boundary lines are fences they are indicated as such.

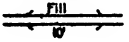
Brush, crops or grass, important as cover or forage


Cemetery

Trees, isolated

Cut and fill — 

cut 10 feet deep



fill 10 feet high

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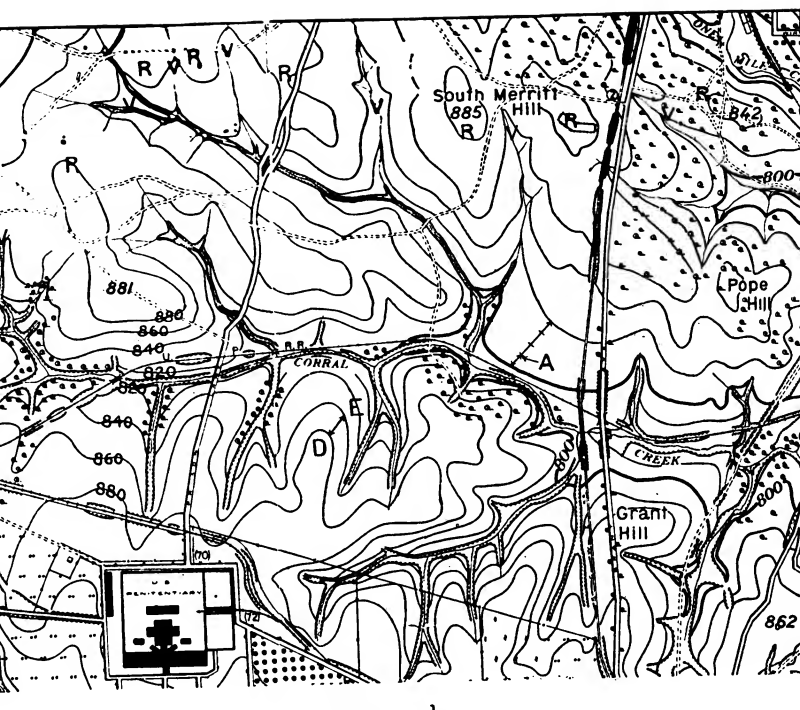


Scale $\frac{1}{21120}$

½ 0

500 0 1000

M.D.

1° 2° 3° 4° 5° 6° 7° 8° 9° 10°

V.I.20ft.

*Datum is mean sea level.*

301121

FLD00100

19.)

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